2nd PANHELLENIC CONGRESS OF MEDICAL PHYSICS
4-6 OCTOBER 2024| EUGENIDES FOUNDATION

End-to-End verification of the Cyberknife Lung Optimised Treatment (LOT) function using film dosimetry

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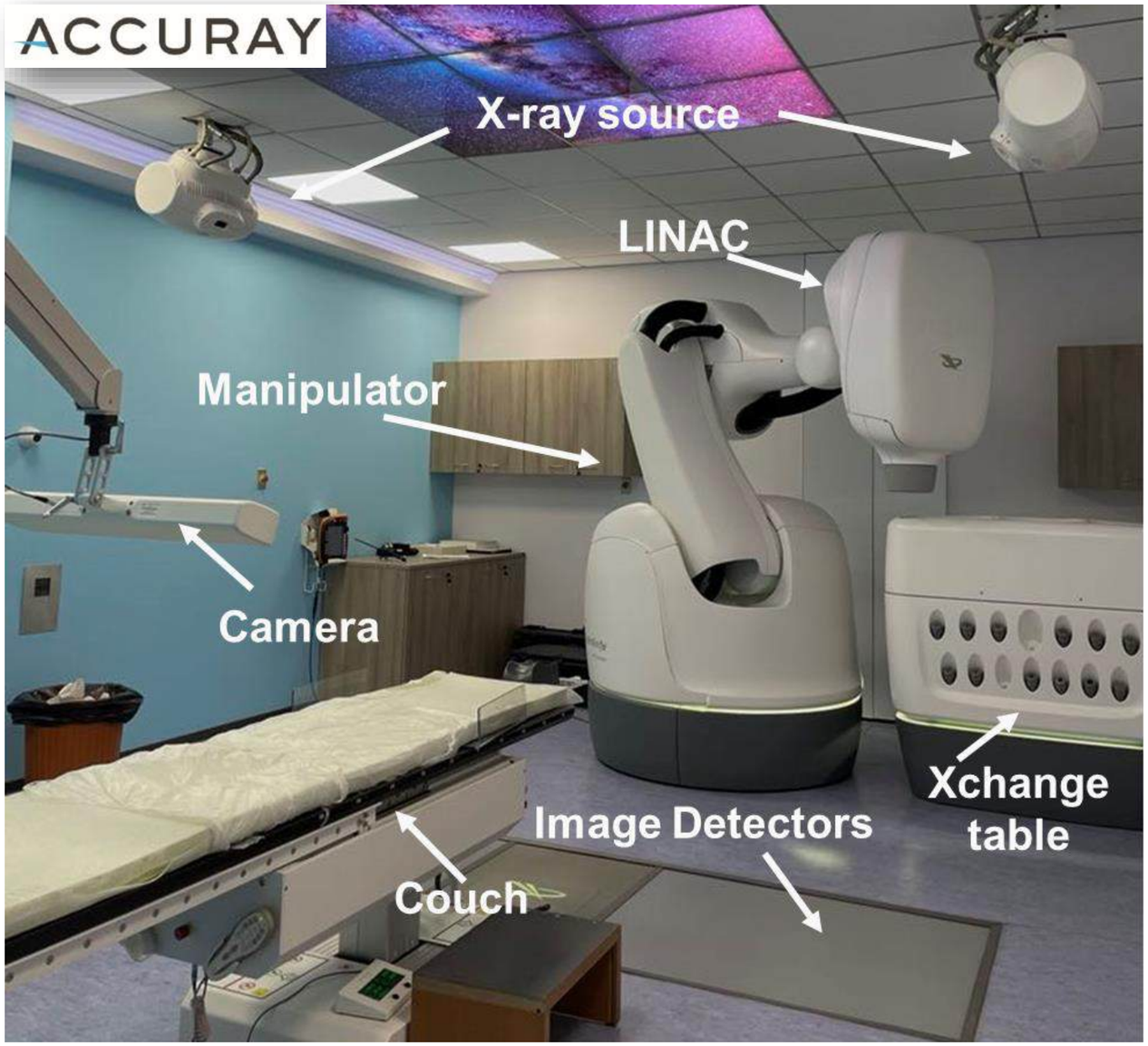
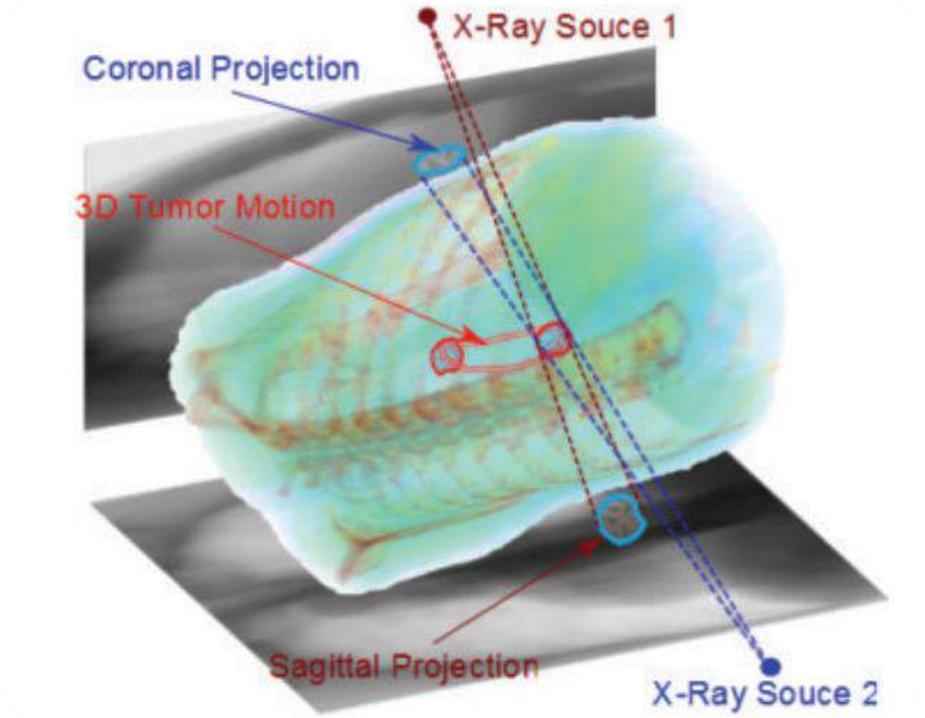
CyberKnife® System

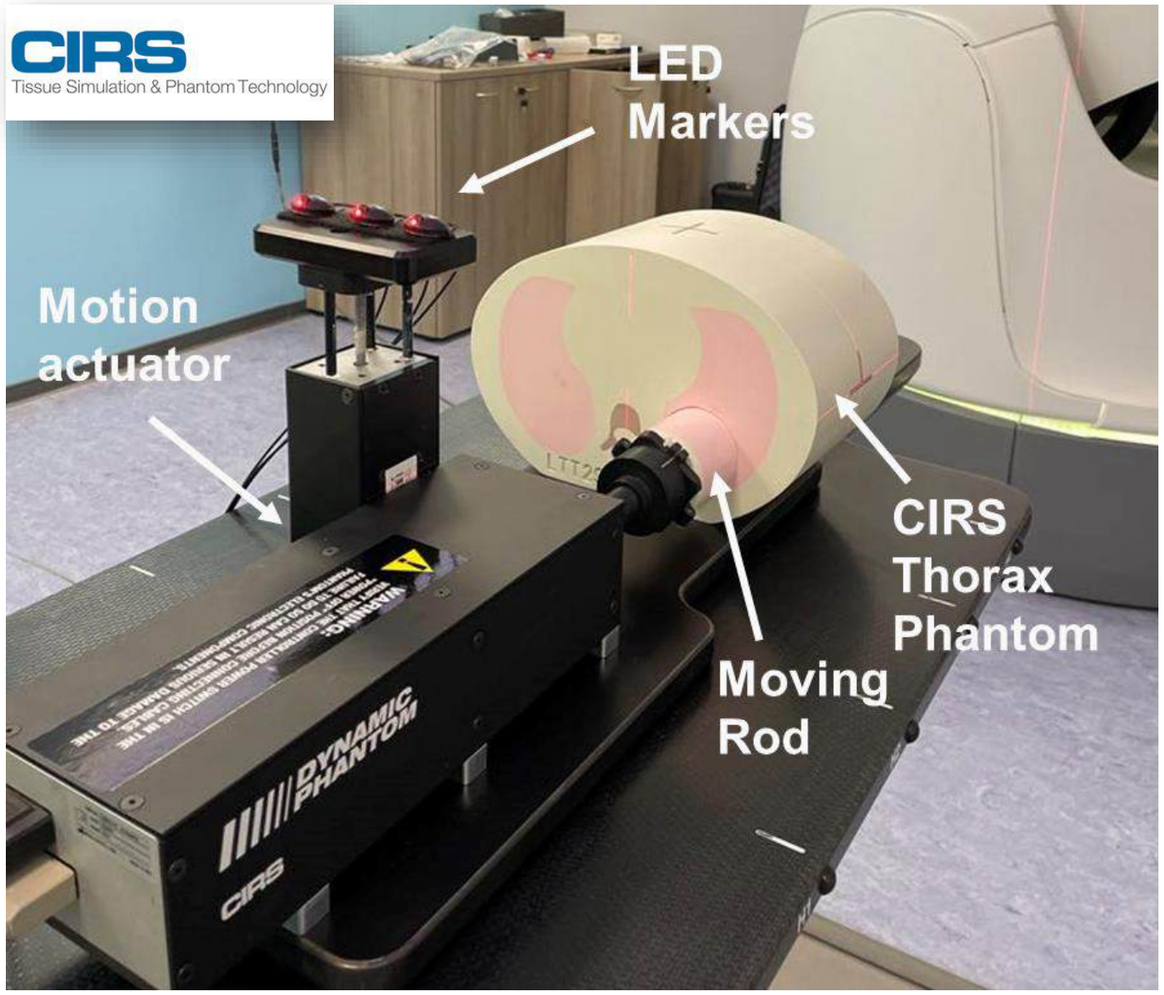


- Lung optimized Treatment (LOT) function → fiducial-free lung SBRT with the Synchrony Respiratory Tracking System
  - 2-view tracking
  - 1-view tracking
  - 0-view based treatments.

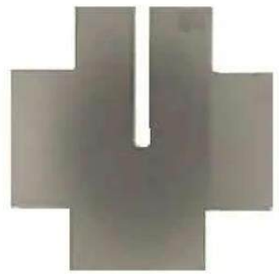


2. Materials & Methods

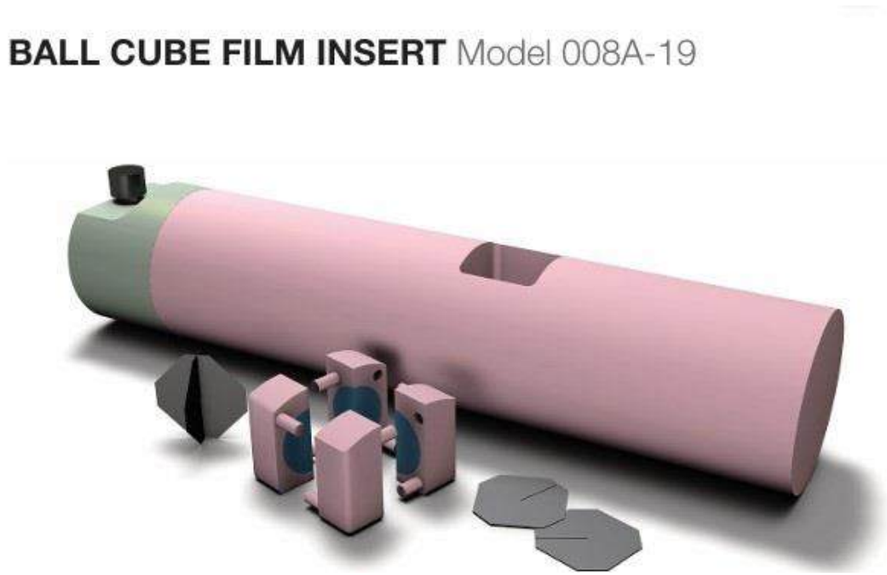
The CIRS Dynamic Thorax Phantom model 008A was used for the experimental verification of LOT treatments.
Static phantom: Static Plan
Moving phantom: 2-View, 1-View Tracking Plan and Spine-Supine Plan



Gafchromic
EBT3 – XLT films

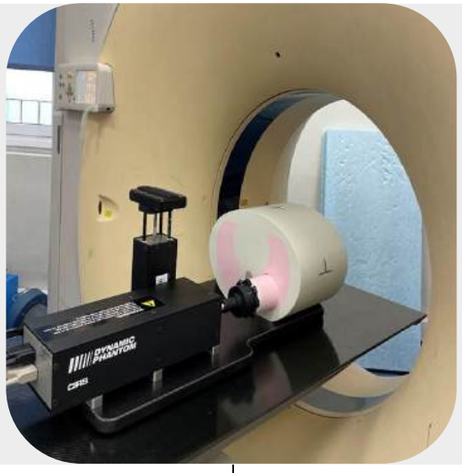


← *Motion parameters*: $\cos^4$ motion model, 10 mm along the sup-inf direction

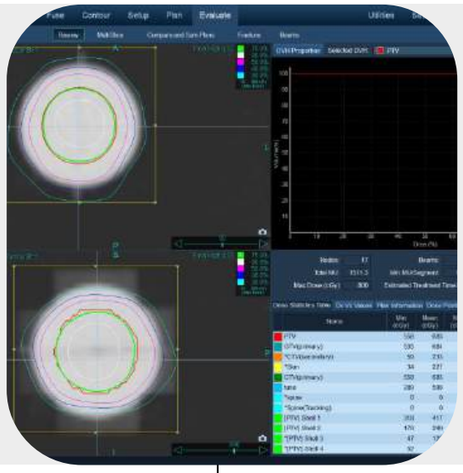


2. Materials & Methods

Experimental Procedure



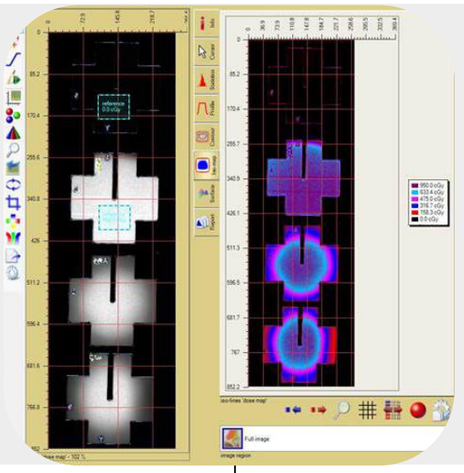
Planning CT Of Dynamic Phantom



Treatment Planning

Film Calibration

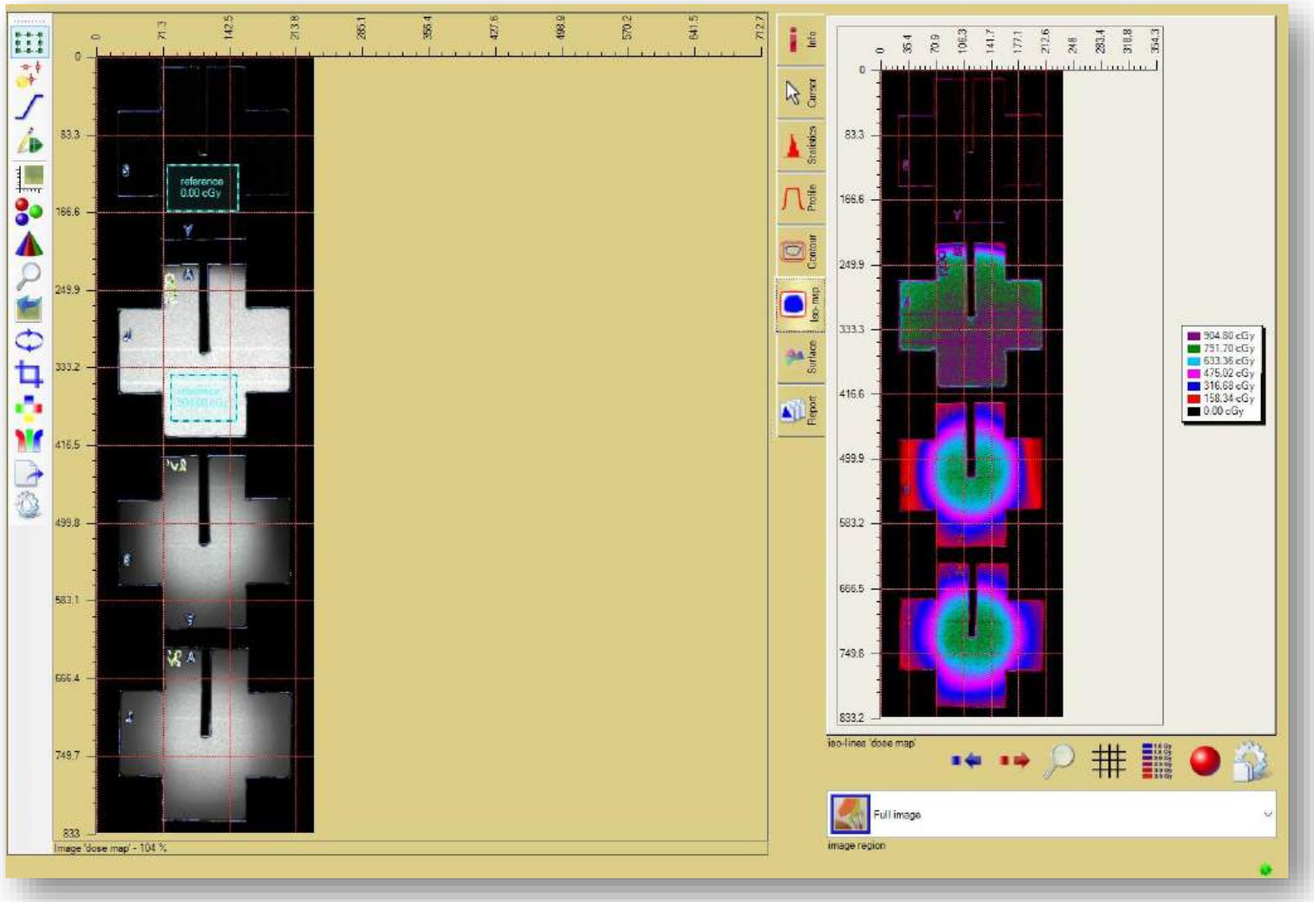
Phantom Irradiation



Film Analysis

2. Materials & Methods

- 2D absolute dose measurements were performed in axial and sagittal planes with dose calibrated Gafchromic EBT3-XLT films and the FILMQA Pro software.
- One-scan protocol was used to reduce errors up to 2%.
- *Motion parameters*: $\cos^4$ motion model, 16 mm along the sup-inf direction



Plan Overview	
Treatment Planning System	Accuray Precision version 3.3.1.2
Optimization Method	VOLO
Dose Calculation Algorithm	1. FSPB-LS 2. MC
Prescription	75% Isocurve, 600 cGy
Maximum Dose	800 cGy
Collimation	MLC

3. Results

MC vs FILM

Axial Plane

Sagittal Plane

Static Plan

2-View Tracking Plan

Static Plan

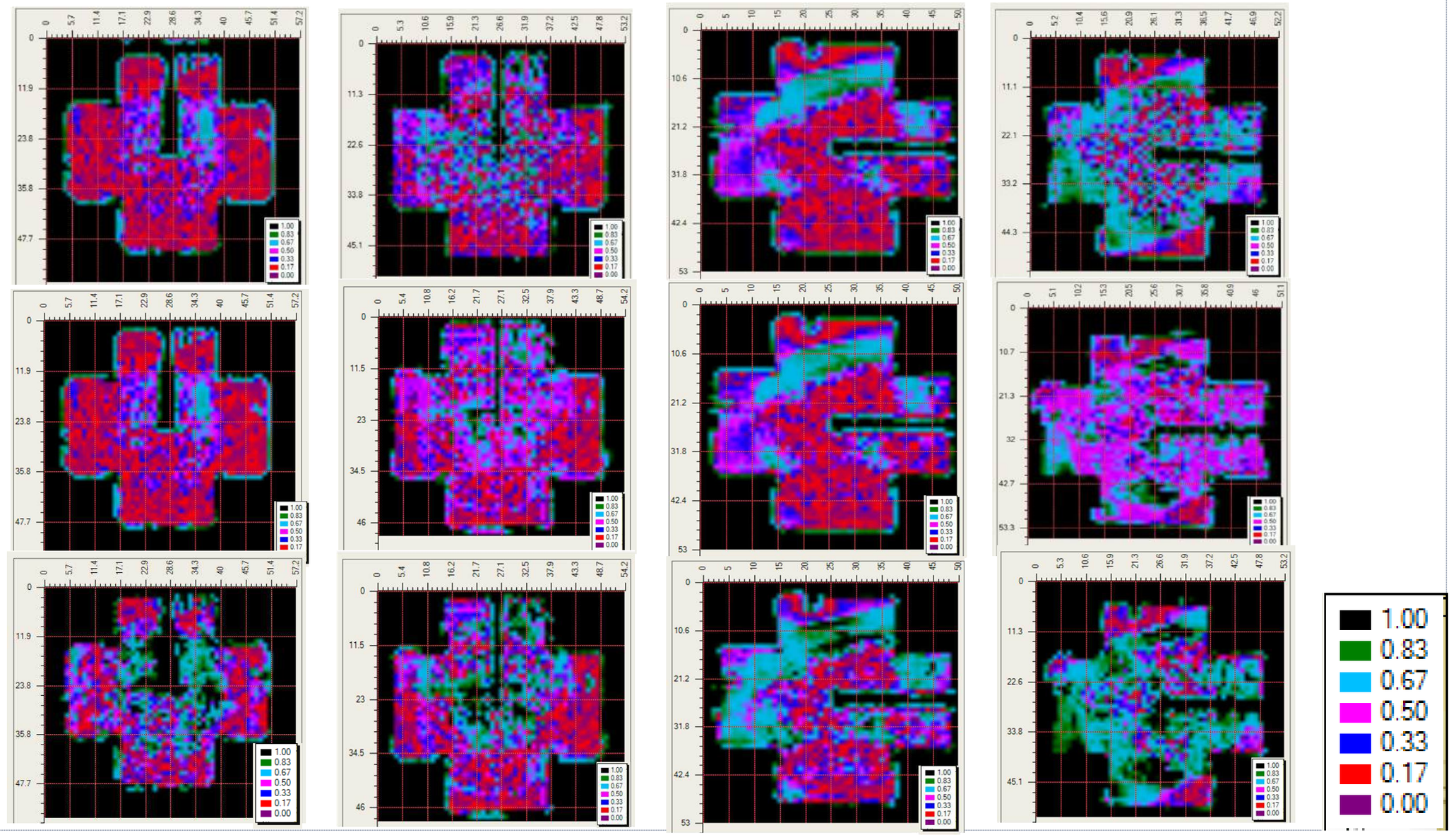
2-View Tracking Plan

Gamma passing rate criteria

5% / 1mm

3% / 1.5mm

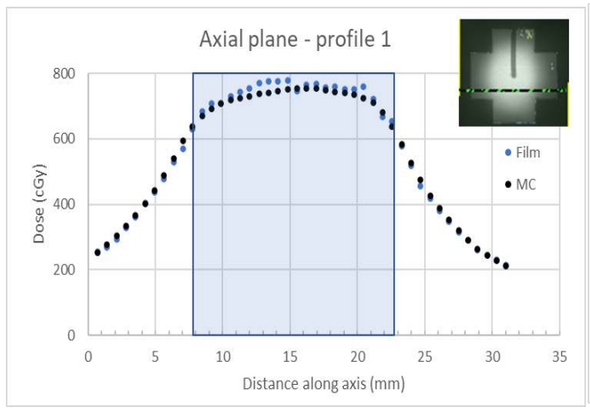
3% / 1mm

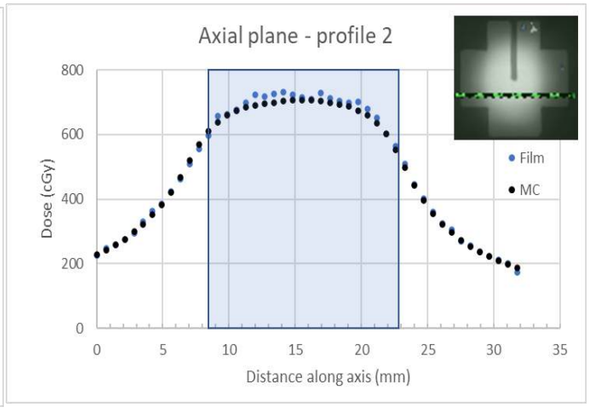


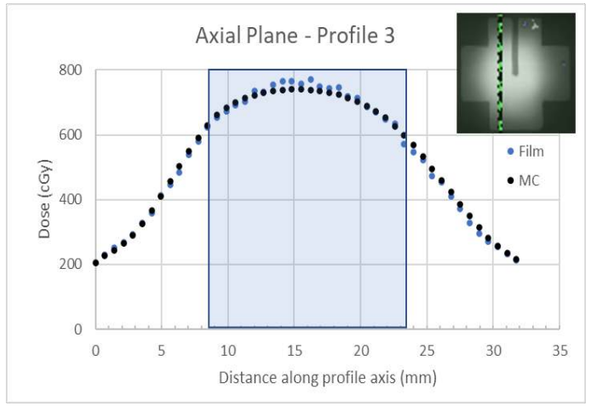
3. Results

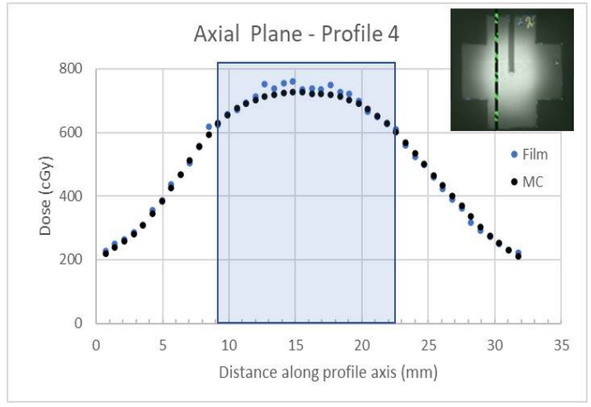
2-View Tracking Plan
Film-MC : Dose Profiles

Axial Plane

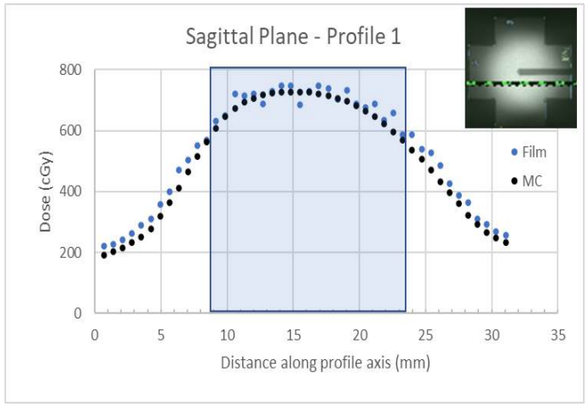


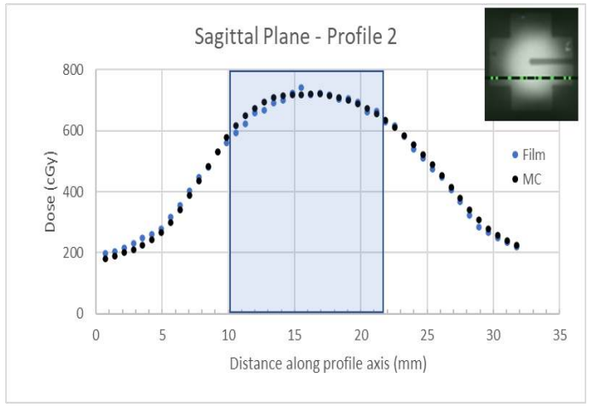


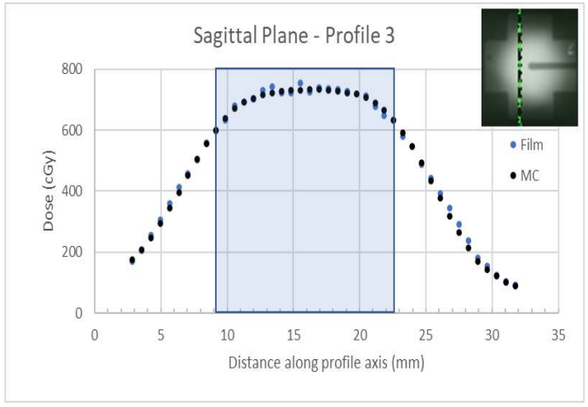


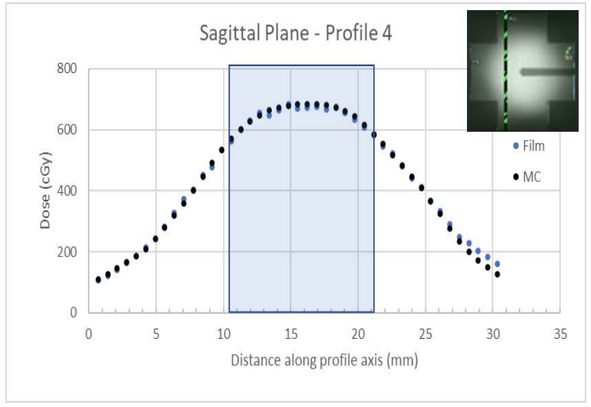


Sagittal Plane



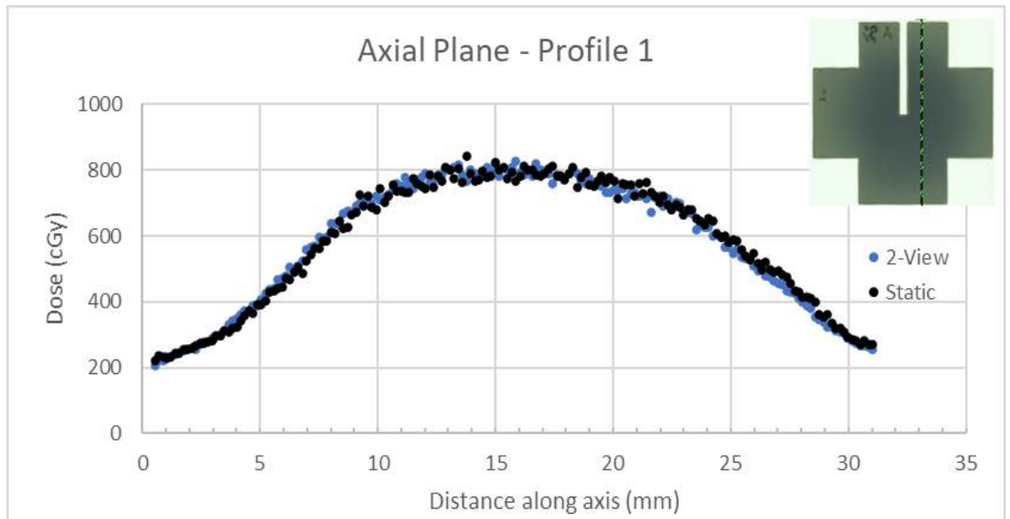


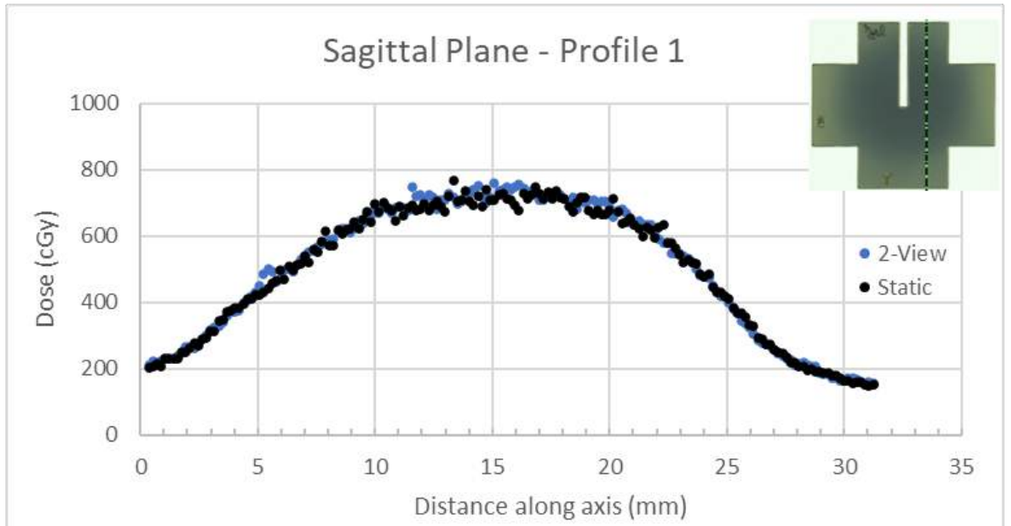


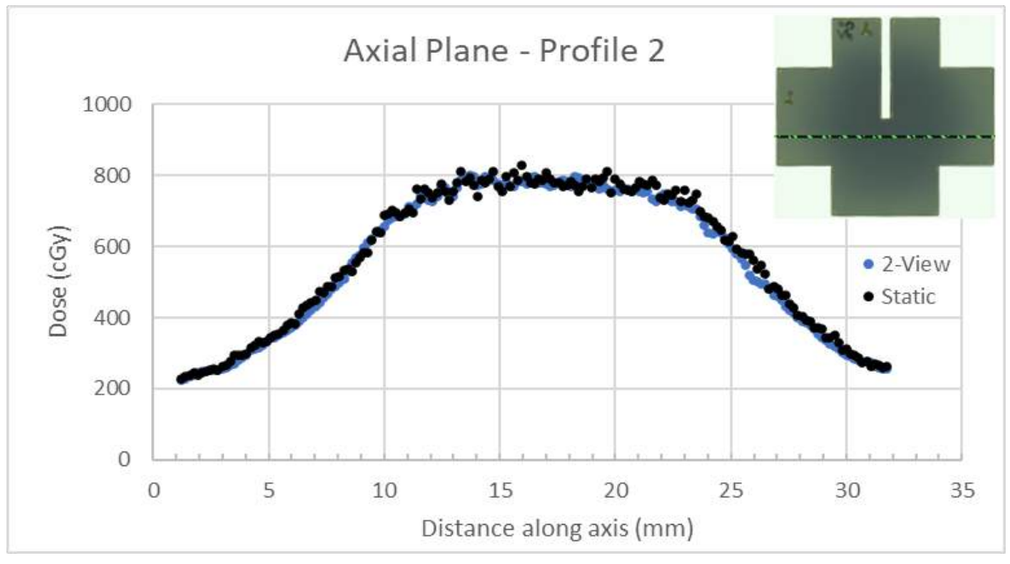


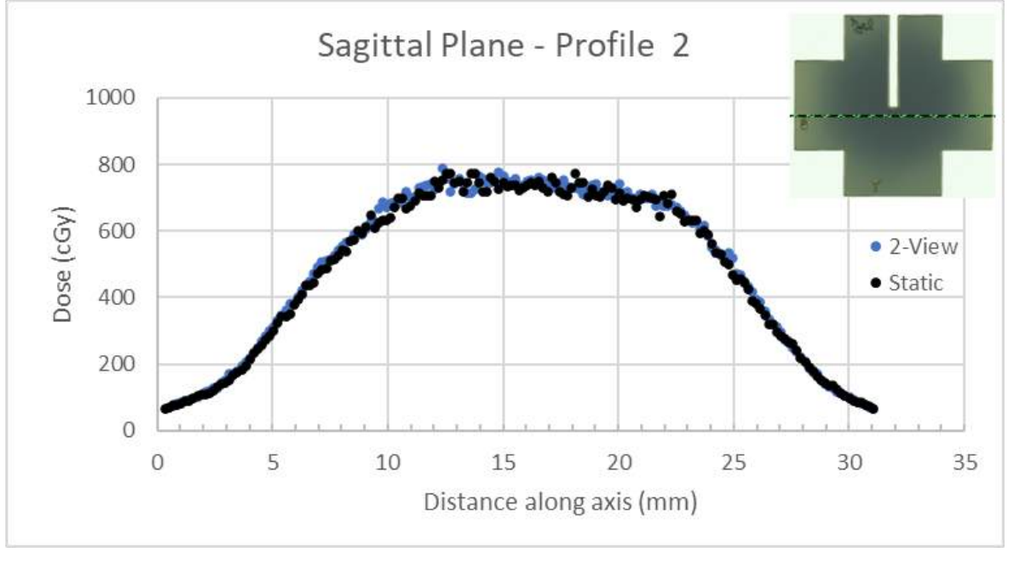
3. Results

2-View Tracking Plan VS Static Plan
Film Comparison





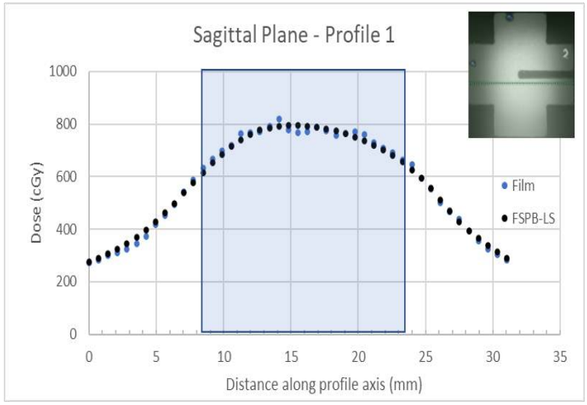


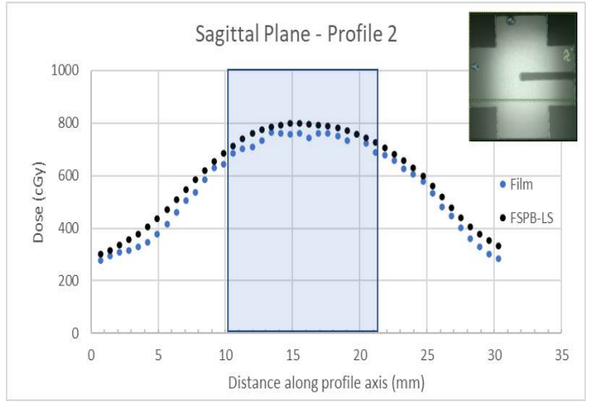


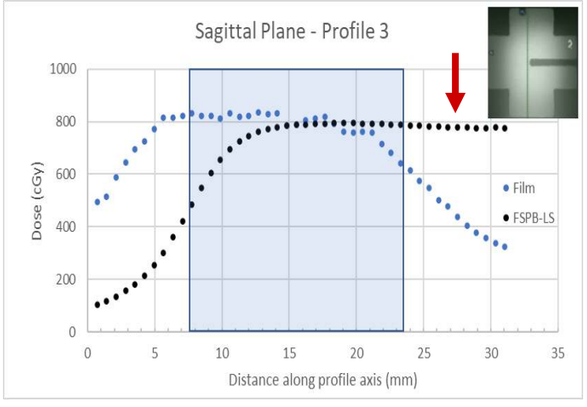
3. Results

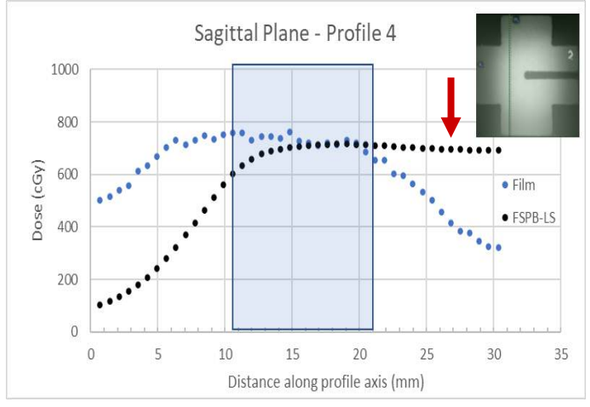
Spine – Supine (0-View) Plan
Sagittal Plane : Dose Profiles

Film- FSPB-LS

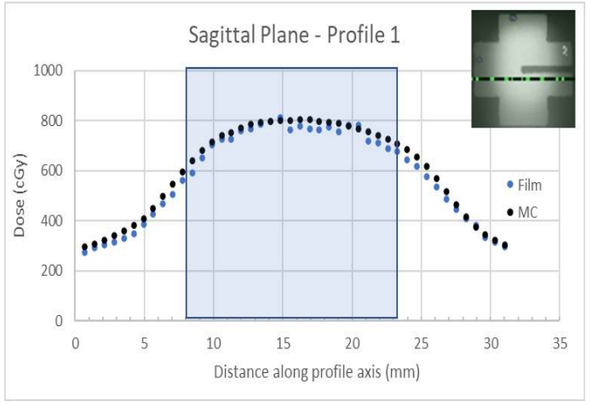


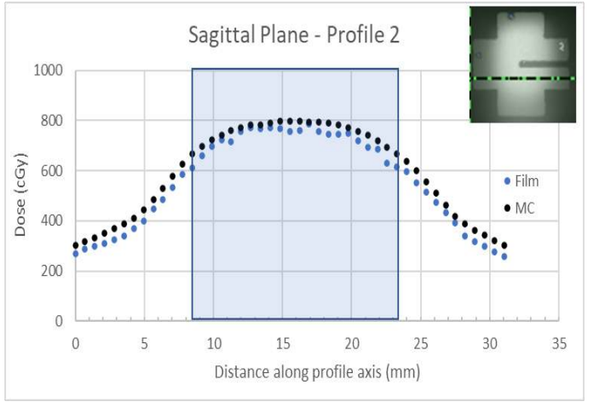


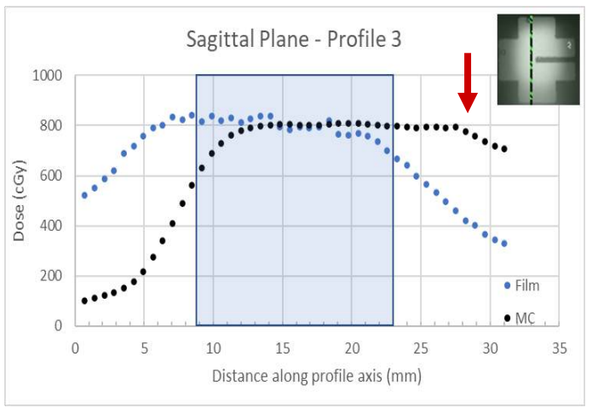


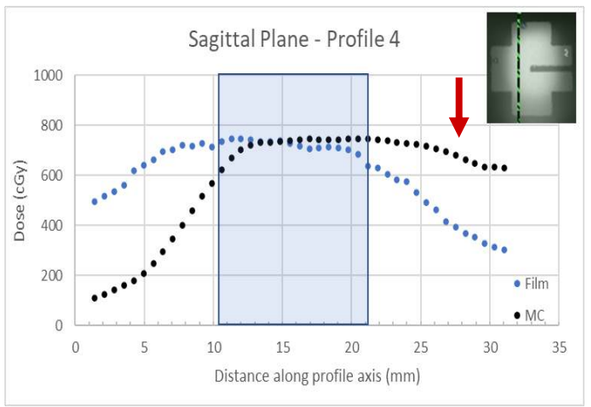


Film- MC









4. Conclusions

Radiochromic EBT3 film dosimetry with a dynamic chest phantom is an effective method for E2E dosimetry in Lung SBRT with the CyberKnife system.

The Monte Carlo calculation algorithm is in very good agreement with the measured doses: Gamma passing rate $\gamma > 97\%$ (3%, 1mm).

Accuracy in monitoring and real time tumor tracking confirmed (Movement: Sup-Inf, $\cos^4$, 16mm).

In the case of the Spine-Supine (0-View) plan, deviations to the absorbed doses to the tumor and the surrounding tissues are observed depending on the complexity of the treatment plan and the direction of tumor movement (→ direction of the ITV extension).